



Technological and Operational Support for Car shAring

Detailed Evaluation Plan

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Executive Summary

TOSCA (Technological and Operational Support for Car shAring) is a research project co-funded by the Information Society Technologies Programme of the European Union. In the project consortium, valuable expertise in the field of car-sharing is combined.

The key objective of TOSCA is to promote the take-up of mature, but insufficiently deployed leading edge technologies as well as innovative implementation and business concepts of car-sharing. TOSCA aims to establish the integrated, IST-based car-sharing concept (as an element of flexible and intermodal door-to-door mobility services) as European Best Practice and to prepare for further take-up in European cities.

In order to achieve these key objectives, the following operational goals have been defined:

- Transfer of innovative and technological tools of the car-sharing scheme in the City of Bremen (supplier) to the public transport operator ATC-Bologna (user).
- Develop and implement a pilot application of car-sharing in the City of Bologna, based on the implementation and business concept of the car-sharing system in Bremen.
- Develop a business and technical implementation plan for three European cities: Barcelona, Bucharest and Strasbourg.
- Disseminate the project results and best practice examples of car-sharing.

The IT-based car-sharing pilot application in Bologna and the preparation for take up in Barcelona, Bucharest and Strasbourg provide a concrete sustainable development perspective and aim to improve the quality of life in European cities by reducing car ownership and mileage.

Overall Evaluation Framework

Workpackage 4 (WP4) evaluates whether the TOSCA project has been successful in meeting its objectives. WP4's key role is to determine in how far the transfer of a car-sharing system was successful and to establish which are the benefits for the car-sharing operator and users. The results from the evaluation process will provide important input for other car-sharing take-ups and transfer projects.

Rupprecht Consult is in charge of implementing the work of WP4. A close co-operation with ATC and INVERS, which will gather the data required for evaluation (WP3), is ensured. The main aspects considered in establishing a common evaluation basis are:

- Impacts and indicators common to all TOSCA partners concerned with evaluation, esp. Rupprecht Consult, ATC Bologna and INVERS and
- Indicators selected for measurement at all sites need to be measured in the same way, or at least yield comparable results, across the sites.

Applications and Appraisal Groups

The appraisal groups to be involved in TOSCA evaluation are:

- Car-Sharing Users (Users from the small business sector, students, residents)
- ATC (as car-sharing provider and operator)
- Intermediate (call centre, INVERS (system provider and support))

Impacts, Indicators, and Assessment Methods

In an evaluation workshops and various other consultations the evaluation team defined the impacts, indicators, and assessment methods as the key elements of the evaluation process. The expected TOSCA impacts are:

- Impact 1: User friendly car-sharing system (user perspective)
- Impact 2: Ease of operation (provider perspective)
- Impact 3: Economic viability of commercial car-sharing operation in Bologna
- Impact 4: Contribution to sustainability

For each expected impact, clear assessment objectives and operational indicators have been identified and described. Throughout these exercises, an effort was made to reach the highest degree of agreement within the TOSCA project consortium in defining these key elements of evaluation.

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1 Introduction

1.1 Guide to the Reader

Due to the public nature of this document, the intention has been to prepare a comprehensive, stand-alone report. At the same time it should reflect the consolidated agreement process within WP4 'Assessment and evaluation of results' of the TOSCA project.

In order to serve different groups of readers best, a certain degree of redundancy is apparent in this document. Readers find the following information in the respective chapters of this document:

- A brief overview of TOSCA is provided in chapter 1.2 for readers unfamiliar with the project.
- The Bologna implementation framework is outlined in chapter 1.3.
- Chapter 2 describes the agreed evaluation structure and provides definitions of key terminology.
- Chapter 3 contains the technical core of the evaluation framework, including descriptions of impacts, indicators, reference cases, success criteria, and methods of assessment. Finally it links the evaluation results to the overall TOSCA project objective by elaborating future evaluation tasks.

1.2 An Overview to the TOSCA Project

Car-sharing is a modern mobility service which allows its users to use a car at any time without having to own an individual vehicle. In car-sharing organisations, many people use few cars – only as long as needed. A well-organised car-sharing service, in conjunction with a good PT network, may give even a higher flexibility than a private car - with higher economic and ecological efficiency. Organised car-sharing completes the network of environmentally friendly means of transport (public transport, walking and cycling). It works like a mobility insurance for all cases where public transportation, walking and cycling are not adequate.

Some car-sharing success stories already exist. However, the overall awareness of the benefits of car-sharing, the organisational know-how and the currently available technologies for building up a reliable and user friendly car-sharing system have yet to be sufficiently deployed in Europe. More importantly, most car-sharing approaches today are still not technology-based and they do not include any substantial co-operation with other transport modes.

1.2.1 Project Objectives

The key objective of TOSCA is to promote the take-up of mature, but insufficiently deployed leading edge technologies as well as innovative implementation and business concepts of car-sharing. TOSCA aims to establish the integrated, IST-based car-sharing concept (as an element of flexible and intermodal door-to-door mobility services) as European Best Practice and to prepare for further take-up in European cities.

In order to achieve these key objectives, the following operational goals have been defined:

- Transfer of innovative and technological tools of the car-sharing scheme in the City of Bremen (supplier) to the public transport operator ATC-Bologna (user).
- Develop and implement a pilot application of car-sharing in the City of Bologna, based on the implementation and business concept of the car-sharing system in Bremen.
- Develop a business and technical implementation plan for three European cities: Barcelona, Bucharest and Strasbourg.
- Disseminate the project results and best practice examples of car-sharing.

Targets

Within the TOSCA project, ATC Bologna has the intention to implement a car-sharing pilot application with nine vehicles, placed at three car-sharing locations in the city centre. To ensure a high quality of customer services and environmental friendliness, the Bologna car-sharing scheme shall comply with the following emerging standards for car-sharing operations¹:

- 24-hr service and accessibility, in order to offer a real alternative to private car ownership
- Fee structure based on mileage, in order not to give an incentive to driving more than necessary ("pay as you drive" structure)
- Use of low emission vehicles (compliant with EURO III norm at least)

The implementation of the pilot car-sharing technology elements and the corresponding business concept shall help to reach the targets defined below. These targets will be projected for three years on the basis of the business plan estimates for the use of car-sharing in Bologna.

Business targets*	Sustainability targets*
<ul style="list-style-type: none"> • Achieve a number of 100 regular car-sharing customers. • Achieve an operational efficiency above 25 % compared to a base case of non-IST-based car-sharing. • Set up a car-sharing operation in Bologna with at least 15 car-sharing vehicles, which fully covers all operational costs within two and a half years. 	<ul style="list-style-type: none"> • Reduce the number of kilometres driven by the car-sharing customers by 160.000 kilometres annually². • Increase the use of public transport means of the car-sharing customers by 25%. • Reduce the total number of registered vehicles in Bologna by 50 (gross reduction due to car-sharing). • Gain 500 m² of urban space³. • Reduce the CO₂ emission of the car-sharing customers by 32 tons annually⁴.

* Targets are projected for three years.

¹ These standards have been defined in Germany by the Independent Jury "Umweltzeichen" (Eco-Label) in May 1999 as requirements for the labelling of car-sharing.

² Starting year 2002 and based on the experiences of the City of Bremen, it is assumed that each car-sharing customer will reduce the number of kilometres driven by about 1.600 km per year.

³ Based on: 50 vehicles x 2m x 5m.

⁴ Starting year 2002

1.2.2 Project Structure

The project consortium combines valuable expertise in the field of car-sharing. An overview of the TOSCA consortium is provided in Table 1.

The EU cities of Barcelona and Strasbourg as well as the CEEC city of Bucharest are associated as follower cities.

Table 1: The TOSCA Consortium

Participant Name	Country	Status
ATC Bologna	Italy	Co-ordinator
Freie Hansestadt Bremen, Der Senator Bau und Umwelt	Germany	Member
INVERS GmbH	Germany	Member
Rupprecht Consult GmbH	Germany	Member
POLIS a.s.b.l.	Belgium	Member
EUROCITIES ASBL	Belgium	Member
Cambio	Germany	Sub-Contractor

The TOSCA project started in September 2000. It will be implemented in seven workpackages. The project duration is 18 months (see Table 2).

The workpackage structure as well as the content of all project tasks in the different workpackages are described below. The exact timing of the project work follows the general process required to carry out a Take-up Action.

Table 2: TOSCA Workpackages

Workpackage (WP) Number	Description
1	Implementation planning
2	Technical implementation
3	Operation and measurement of results
4	Assessment and evaluation of results
5	European transfer planning
6	Dissemination of best practice
7	Project co-ordination

WP1 will include all tasks for planning and preparation of the car-sharing take-up in Bologna. Since a general feasibility study on car-sharing has already been prepared, the implementation planning phase only has to identify the specific preconditions for physical implementation, business planning and marketing before the take-up of car-sharing technologies can take place. In the planning phase, it is also essential to finally determine the exact technological implementation parameters.

In **WP2**, all software and hardware elements for the car-sharing scheme in Bologna will be installed. After successful installation the system will be tested and the car-sharing staff will be trained.

After the preparation phase which includes planning and technical implementation, the car-sharing system will start operation in **WP3**. In the operation phase, comprehensive data for evaluating the effects of the car-sharing application will be collected.

WP4 evaluates whether the project has been successful in meeting its objectives. Evaluation will comprise analysis of changes in mobility behaviour of the users, of social and environmental impacts, and of the extent to which the quantified objectives have been met.

WP5 and **WP6** refer to the TOSCA objective to promote take-up of the car-sharing experiences in the Cities of Bremen and Bologna to other European cities. In **WP5**, TOSCA will give concrete support to three European "follower" cities to develop car-sharing implementation and business studies. **WP6** includes the organisation of dissemination events which target a wider audience of local transport decision makers in Europe in order to increase the awareness of the benefits of car-sharing. Other tasks are preparation of a best practice study and www-dissemination of results.

WP7 is a horizontal workpackage that includes the activities for project management. Project management consists of the continuous co-ordination and monitoring of project progress and reporting tasks.

1.3 Bologna Implementation Framework

The city of Bologna, situated in the North of Italy, is the seventh largest city of Italy as far as the number of inhabitants is concerned. It is the seat of the local government of the Emilia Romagna region and covers an area of approximately 140 km². A population of about 600,000 inhabitants lives within the metropolitan area including the neighbouring municipalities. Sixth in economic importance, it is well known as a city with high quality life standards, there is in fact a long tradition of providing services to citizens (e.g. educational, social, cultural, sports). Up to 250,000 vehicles are on the move in this area every day, obviously generating traffic, congestion and pollution problems.

ATC Bologna

ATC S.p.A. operates urban, suburban and interurban public road transport in the whole Bologna City area and it is also in charge of the management of city parking on behalf of the City Council. ATC's fleet consists of about 900 buses, half of which run on urban routes, 150 on suburban routes, and the remaining 300 on extra-urban routes. About 100 million passengers are carried annually, tendency slightly increasing, partly due to the introduction of a policy aimed at encouraging public vehicle use by adopting innovative systems and transport means which can harmonise both citizens' needs and environmental requirements.

The company is particularly keen on developing modern strategies and technological tools for managing the transport demand and overcoming traditional restrictions, and alert in supporting the newest transport models in order to guarantee a service becoming more effective and efficient day by day.

Within the TOSCA project, ATC will carry out a car-sharing pilot application, called "CarAtc"⁵.

The following chapter summarises the implementation framework for car-sharing in Bologna.

⁵ In Italian, "CarAtc" also means "Dear ATC" (Cara ATC, *it*).

1.3.1 ATC's Car-Sharing Strategy

A successful car-sharing project requires detailed planning. Specific conditions have to be identified for physical implementation, business planning and marketing. For this reason a pre-study has been carried out in Bologna in 1998. On this basis the exact technological implementation parameters have been determined and their functionality will be tested during the pilot phase. The TOSCA project results will be integrated and exploited within the future ATC car-sharing strategy in Bologna⁶.

ATC's Car-Sharing Goals

The main goal, once the car-sharing service will have been set on a firm basis in the future (presumably in January 2002) is to satisfy user mobility needs at least on the same level as private car ownership. Car-sharing must, in fact, represent a valid alternative to car owning.

The advantages, both individual and social, resulting from a better rationalisation in the collective use of vehicles, are numerous. From a social point of view, environmental measures (reduction of air pollution due to low emission vehicles) and car space minimisation undoubtedly produce remarkable benefits for the community. From an individual point of view, the advantages are even more immediate: time saving for example. In the car-sharing system no maintenance or cleaning activities are required from the user, no parking problems arise. The car-sharing user only uses the vehicle when needed.

Benefits can also be achieved from an economical point of view. By sharing fixed management costs among users through a proportionally defined tariff structure it will be possible to obtain important savings and to ensure an economic balance.

General goals for achieving the best results within the car-sharing experience can be synthesised as follows:

- Address multiple car ownership with the goal that just one private car is kept, and all additional cars are given up because of car-sharing.
- Convince 25% of the pilot car-sharing costumers not to buy a car (first or additional one),
- Urban space conservation, which means freeing 360 m² surface from car occupancy (considering that each CARATC supposedly replaces 4 cars),
- About 20.000 kms not driven during the pilot application phase resulting in an environmental benefit equalling 4 tons of CO₂.

Obviously there will be additional advantages coming from car-sharing. Certainly the company image will improve and increase ACT's credibility as a mobility services provider. The company will in fact diversify the range of services offered to citizens and will be able to respond to the specific needs of the market target group.

Furthermore considerable benefits are expected because car-sharing users will use public transport services in order to reach car-sharing locations. It is expected, in fact, that 50% of car-sharing users will get to the car-sharing locations by using at least one public transport vehicle.

⁶ Currently, a project is prepared co-financed by the Italian Ministry of the Environment and Bologna Municipality which was committed to ATC and COTABO (Bologna Taxi operator). Bologna presently adheres to ICS (Italian car sharing initiative).

Business planning

On the basis of the tariff structure defined by ATC it is targeted that at the end of the experimentation phase (calculating the mileage and the time the vehicles are used), car-sharing will yield an income of about £. 100.000.000.

The marginal costs will be about £. 60.000.000 (including insurance, fuel, maintenance, administration, cleaning, marketing, telephone).

However, it has to be taken into account that ATC personnel costs, as well as call centre and appliance costs, are currently covered by the TOSCA project. Investment costs related to cars have not been considered here as the Smart car dealer has provided the vehicles for the whole project experimentation phase at no charge.

1.3.2 Car-Sharing Technology

The COCOS⁷ Standalone System has been selected as adequate car-sharing technology for Bologna. It does not require any fixed installation, giving high flexibility during the test and tuning phase. It is only based on an on-board computer, a contactless card reader and a GSM modem. All devices are inside the car. No installations are required at the car-sharing location. As the locations do not require any fixed structure, it allows higher flexibility in starting new car-sharing stations – following the demand of the market (private users, also following desires of the municipality).

As backoffice software, the COCOS'2000 standard package and additionally the attached Internet Software CocoWeb are used. This software configuration provides a LAN-based distribution of administration clients, reservation clients and billing clients as well as an Internet-based self-service reservation client. The included communication software CUCM performs the GSM communication.

The operative system used is a Microsoft Windows NT server (with updated service pack) and the WEB server is Microsoft IIS 4.0. The database engine is Microsoft jet engine (MS Access97).

Booking

As a starting point, ATC envisages a first possibility to set up a mobility Call Centre that will take care of the car-sharing customers. A problem is represented by the actual availability of the service of only 12 hours a day. In the future, the existing Call Centre will be supported for reservation activities by the Taxi Company Call Centre (COTABO) which is available 24 hours a day.

Therefore the software module "CocoLite" will be installed in the taxi call centre. The taxi call centre staff will be able to perform simple reservation tasks (e.g. make a new reservation, edit and revoke existing reservations) via a TCP/IP connection with the central reservation system. The TOSCA call centre will also work with CocoLite for standard reservation tasks. For special customer services, there will be one workstation with a full CocoBook installation at the TOSCA call centre.

In the near future, when an official website (www.caratc.bo.it) will be available, the COCOWEB module for car WEB reservation and general information about the service will also be operative.

TOSCA operators in Bologna have changed the implementation strategy with the idea to have a main and backup server for the call centre and for hardware and software assistance optimisation. Reservation software was installed at COTABO (taxi operator) to ensure 24 hour assistance.

⁷ COCOS: CarSharing Organisation and Communication System

System Verification

During January 2001, the management and reservation software provided by INVERS has been installed on a personal computer. At the beginning there were some problems concerning the GSM configuration modem but they seem to have been solved by now.

In February, two on-board computers (OBC) provided by INVERS have been successfully installed on two Smart cars. Tests results of these two prototypes have been satisfactory.

In March, all remaining seven OBC installations have been completed. The Smart cars have been moved from the Smart depot to ATC in order to define further and more complete tests.

The following tests have been carried out:

- Diverse reservations from the control centre, correct reception of booking,
- Verification of the booked Smart cars and on-board computers' (OBC) behaviour in several situations,
- Comparison between the data recorded in the control centre and real data,
- OBC reliability check (e.g. odometer, users cards reader, immobiliser, GSM modem).

The above tests were useful to adjust the OBC parameters best and to become familiar with the reservation software and the OBC themselves. The overall test results were more than satisfying.

The remaining issues still to be tested before the start of the pilot application are:

- Reliability of the booking SMS reception (a further and closer check is meant to be introduced),
- Integration of the billing software into the control centre.

Thanks to the experimentation results, some manuals and user instructions are currently being prepared in Italian which take into account the experiences gained by ATC (e.g. leaflets, brochures, contracts sponsoring the project, instructions about operational and legal aspects.)

1.3.3 Car-Sharing Vehicles and Tariff Structure

In the TOSCA car-sharing pilot phase, ATC only offers one type of vehicle: Smart⁸. In the future, ATC plans to broaden the scope of cars available for car-sharing.

INVERS has installed a tested on-board computer inside the Smart vehicles, the device has already been tested in Germany and in Bologna for a few cars beforehand. In Germany, INVERS has gained comprehensive experience and uses specific installation devices and procedures for the car types most widely used.

Graphical design will be uniformed according to the ATC co-ordinate image below.

⁸ The vehicles are provided free of charge by the Smart car dealer in Bologna.

Figure 1: ATC Car-Sharing Vehicle

Photo: ATC

Tariff Structure

During the car-sharing pilot application, the tariff structure will be rather simple. The tariff will be the same all week. It will basically be calculated on time of use plus run km in order to guarantee cost coverage. The applied tariff will be: £.2500/h and £.500/Km.

In the pilot phase, ATC aims to investigate the level of user acceptance of the tariff structure. In the future, a double tariff scheme (one for working days and one for Sundays) could be defined if users' reaction to the initiative is positive. At this stage, the TOSCA organisational team has to understand whether the market place of Bologna and the users' preferences allow for other options. In this case, tariffs might be updated and personalised to:

- Optimise vehicle use
- Better meet users' needs
- Provide diversified tariffs, e.g. reduced tariff on weekends
- Guarantee economic stability of the car-sharing organisation

1.3.4 Car-Sharing Locations

According to the pre-study, the most suitable area for a car-sharing service in Bologna is the historical city centre.

This area, in fact, corresponds to some specific characteristics that make car-sharing a quite interesting initiative and a valid service:

- High population density (12.295 inhabitants/ km², last update on 31.12.1999),
- Few parking areas (The Parking Plan has estimated a maximum number of 11.500 vehicle parking spaces in the historical centre until 31.12.1999),
- High garage costs,
- Limitations to vehicle circulation and parking.

Further attractive areas, but with less potential, have been identified neighbouring the historical centre, such as S.Orsola General Hospital, Porta S.Donato area, and Porta Saragozza. In such areas the large numbers of residents, parking regulations and high demand due to the points of attraction in these areas make car-sharing really desirable.

The suitable locations are situated both in the historical centre and in the outskirts, taking into account the main points of attraction such as parking areas, railway stations, university sites, hospitals, and big shopping centres.

Moreover, there is another aspect to be considered. 'Societies and bodies' (companies, legal bodies), for example, could undoubtedly use a car-sharing service instead of or as supplement to the company fleet. This way their management would be more cost rationalisation oriented and they could also lighten the burden of traffic in their surroundings.

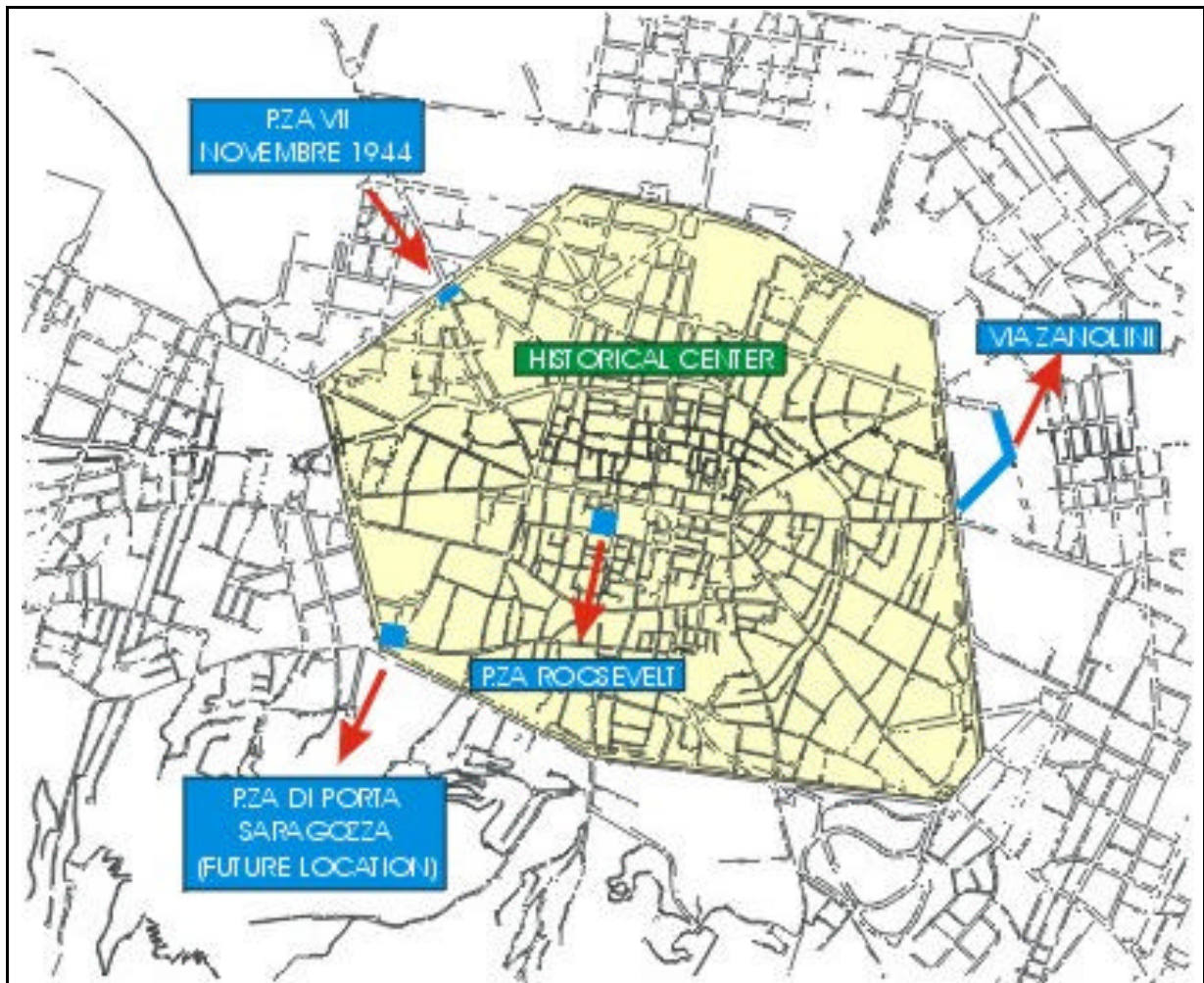
In fact, the main part of these authorities and a high number of companies are located in the historical centre. In order to have an idea of the big centralisation of the productive units and the consequent situation of urban mobility, it is necessary to consider data from the 7th General Census of Industry and Service (1991). The results are that in the city of Bologna, 35% of the companies are situated in the city centre.

Considering the situation described above, ATC has selected the three following car-sharing locations for the TOSCA car-sharing pilot project:

Table 3: Car-Sharing Locations Bologna Pilot

Car-Sharing Location Bologna Pilot	Characteristics
P.za Roosevelt	- Situated in the historical centre, in a very crowded area
P.za VII Novembre	- Close to the main railway station - Situated on the main guiding entries from North
Porta S.Donato/ Via Zanolini	- Located in the University area - Close to the S.Vitale railway station

Figure 2: Bologna Car-Sharing Locations



Source: ATC

1.3.5 Car-Sharing User Group

In order to find pilot users of car-sharing services, ATC has set up a marketing strategy at the beginning of the planning phase. The main goal was to inform and involve the highest number of potential users belonging to different working categories.

ATC has aimed to contact especially the following potential users:

- **Users from the small business sector**
 - Entrepreneurs, advocates, medical staff, architects, freelancers and others
 - Located in the city centre
 - Need (small) vehicle for work
 - Potential: Car-sharing satisfies job-mobility, abandonment of office car
- **Students**
 - Without private car (possibly use of family car brought from hometown or scooter)
 - Potential: Car-sharing prevents the acquisition of a private car
- **Residents**
 - Living near the car-sharing location
 - Public transport users
 - Owners of two cars / multiple car owners
 - Potential: Car-sharing replaces second car / multiple car ownership

An informative campaign has been launched for CarAtc: First of all, TOSCA was officially presented during a press conference. Articles appeared in the local press which gave readers a general overview of the project. Furthermore, ATC contacted the Associations of the Orders (explanation, see before) and ARSTUD (Regional company which finances students). Informative letters were sent to promote the initiative and to ask their members for support in the information activity. Advertising notices were posted in public transport vehicles and dispatched to the ATC and Bologna Municipality informative points.

Moreover, ATC is preparing an informative campaign on buses, in order to reach not only season ticket holders but also 'casual' public transport users.

Potential Users Analysis

As a car-sharing service should favour user mobility, precise information on the real intentions of the future CarAtc costumers was collected in order to pinpoint the different user needs.

Thus, once user contact was provided, CarAtc costumer requirements and mobility needs were investigated. A specifically aimed questionnaire was developed and sent to all people that had expressed interest in participating in the car-sharing pilot. The questionnaire examined for example the users' shift characteristics, reasons for choosing this transport modality, predicted time use and number of shifts during a working week (from Monday to Friday).

Data collection ended on 11 March 2001, after that date further personal details of those people showing their interest and willingness to participate in the project have been collected.

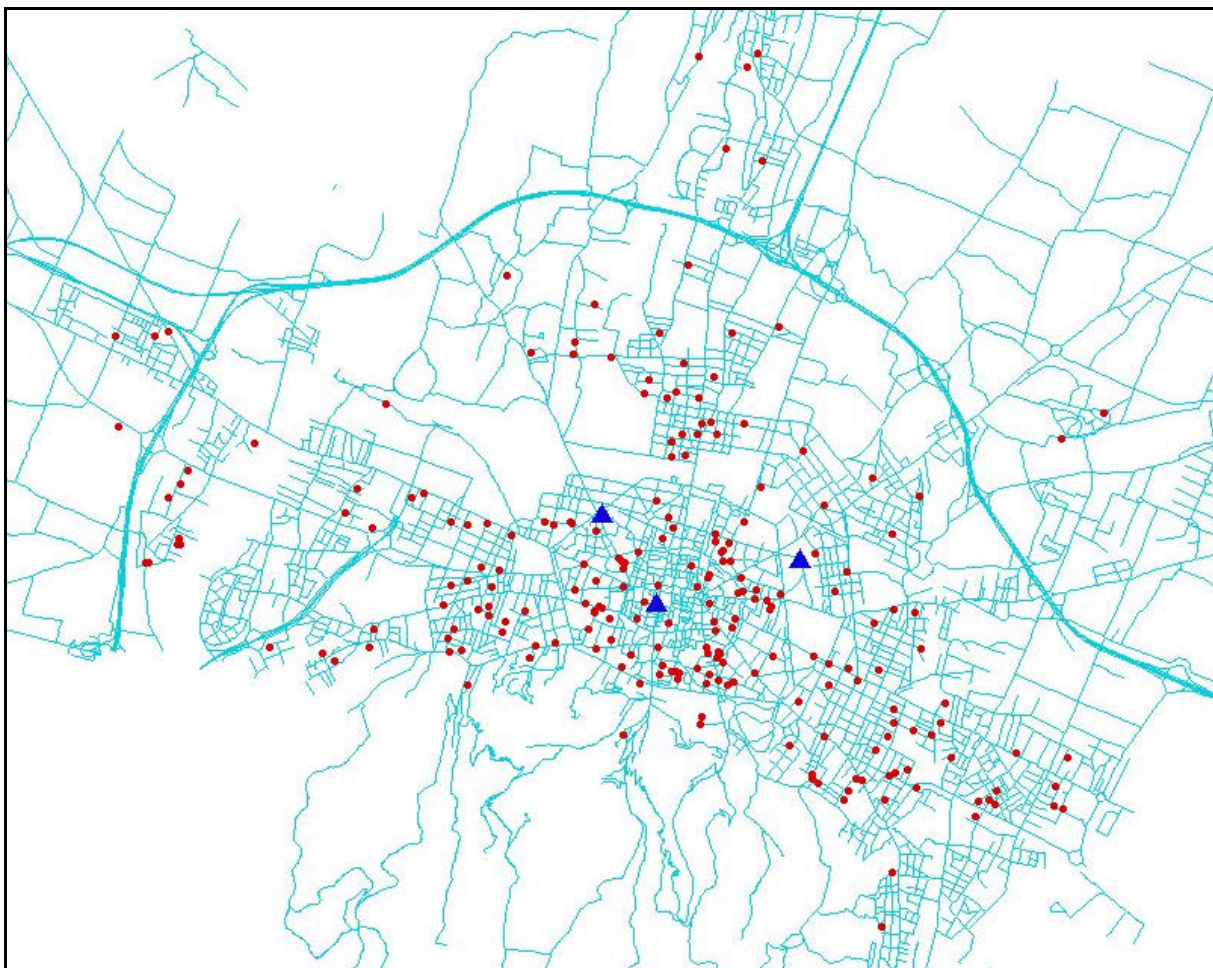
Up to 11 March 2001 a total number of 267 questionnaires were collected⁹. The analysis those who filled in the questionnaire are mainly:

- Male (61%)
- Aged between 21 - 35 years (55%)
- Employees (29%)
- Students (28%)
- Freelancers (16%)

Respondents expressed the highest level of acceptance for the car-sharing location Piazza Roosevelt in the historical centre due to mobility needs (123 expressions of approval).

Figure 3: TOSCA Parking Sites and Residents of Potential Users

TOSCA parking sites: triangles
Users' residents: bullets



Source: ATC

⁹ After that date, other people contacted ATC, their details were integrated in a database. They now represent an important source of future potential users.

As for the judgement on the benefits, the respondents indicated that in their opinion car-sharing:

- Is advantageous for the environment (22%)
- Reduces parking problems (21%)
- Eases mobility comfort (19%)
- Guarantees monetary savings (17%)

Concerning the use of the CarAtc system during scheduled times, it emerges that at night (0:00 – 7:00h) and on Sunday morning (7:00 – 13:00h) the service is not used very much, the percentage varies between 83% and 91% for of no use at night and 80% for no use on Sunday mornings.

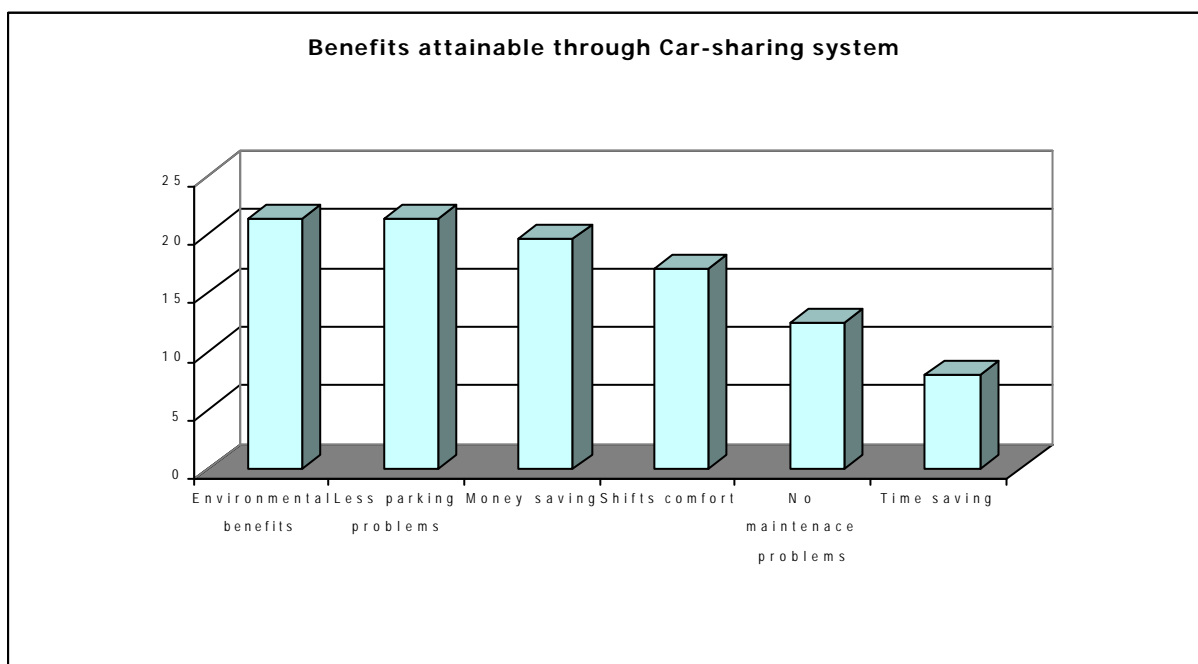
The highest level of use is on Saturday nights (19:00 – 24:00) with 47% of use and Friday afternoons (13:00 – 19:00) with 45% of use.

The principal reasons for using the system during the scheduled time are work and study both in the morning and afternoon hours from Monday to Friday. CarAtc system use for leisure or sports is, instead, prevalent in the evenings and during the weekend. Another important reason for car-sharing usage is shopping, in particular on Fridays and on Saturday afternoons.

On 5 April 2001 ATC organised the first TOSCA information day addressed to the selected users. Detailed technical, contractual issues were discussed.

Presently, 123 pilot users have been selected, according to the categories defined before (small enterprises, students, residents). About 48 of these have already signed the contract (see figures below for more information on these users). The selection process has not ended, yet.

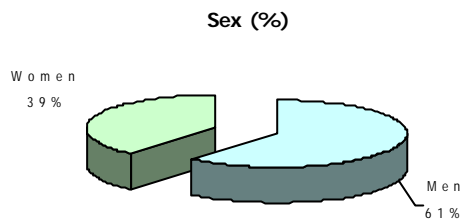
Figure 4: Benefits due to car-sharing expected by present pilot users



Total number of hits (multiple choice): 112

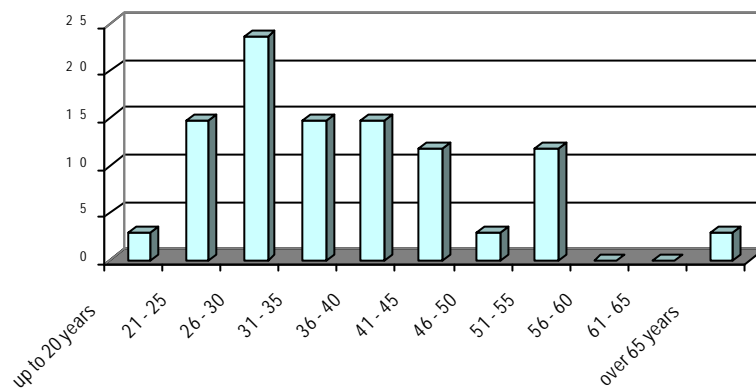
Source: ATC Bologna

Figure 5: Characteristics of present pilot users



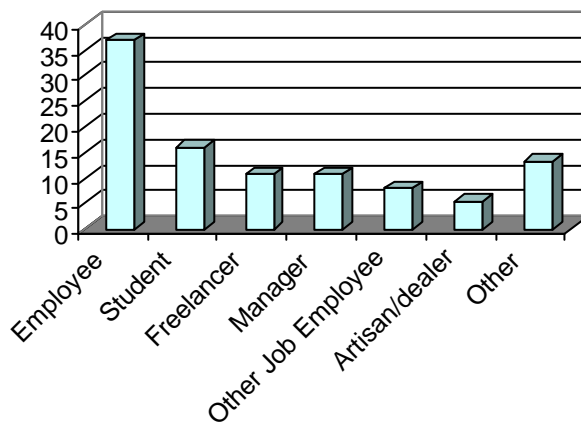
Total respondents: 44
Source: ATC Bologna

Age classes (%)



Total respondents: 34
Source: ATC Bologna

Profession (%)



Total respondents: 38
Source: ATC Bologna

2 Overall Evaluation Framework

2.1 Evaluation Approach

The present Detailed Evaluation Plan is a deliverable (D4.1) of workpackage 4. Workpackage 4 evaluates whether the TOSCA project has been successful in meeting its objectives, under what conditions these objectives were met, and what its wider project impacts have been.

Extensive desk research on evaluation guidelines (ANIMATE, CONVERGE, and VATAM) has been conducted, and actual project evaluation plans in previous European RTD Programmes have been analysed, in order to draft a generic model for assessment tasks in TOSCA as input for forming agreement concerning the TOSCA evaluation.

Within the project, two workpackages are in charge of evaluation, both outlined in the further on:

- WP4: 'Assessment and evaluation of results' of the TOSCA project
- WP3: 'Operation and measurement of results' of the Bologna pilot

One of the major challenges is to reach comparability of WP3 and WP4 (as well as the Bremen and Bologna evaluations). Thus, an evaluation workshop was held by members of Rupprecht Consult, ATC Bologna, City of Bremen and Cambio on 5-6 March 2001 in Bremen. The aim was to co-ordinate WP3 and WP4 activities and to agree on responsibilities, a timetable and details of the Evaluation Plan. Further work on the Detailed Evaluation Plan has been carried out in close co-operation of these partners as well as INVERS.

2.2 WP4 'Assessment and Evaluation of Results' of the TOSCA Project

WP4's key role is to determine in how far the transfer of a car-sharing system was successful and to establish which are the benefits for the car-sharing operator and users. The results from the evaluation process will provide important input for other car-sharing take-ups and transfer projects.

Rupprecht Consult is in charge of implementing the work of WP4. A close co-operation with ATC and INVERS, which will gather the data required for evaluation (WP3), is ensured.

Methodologically, TOSCA strictly follows the Six-Step-Approach for building evaluation into an IST Project¹⁰ and will build on the established practice of technology evaluation in past Programmes, especially TAP and ESPRIT.

The **Detailed Evaluation Plan, D4.1** includes the following elements:

- Identification of all operational goals
- Definition of expected impacts and appraisal groups (i.e. users/non-users affected),
- Definition of evaluation methodologies, reference cases and success criteria.

The Detailed Evaluation Report (Deliverable 4.2) will summarise all assessment and evaluation results. It will contain an analysis of the impacts described in this document. The report will summarise the European Added Value achieved by the TOSCA project. It will clearly outline the lessons learned and results gained by using Information Society Technologies (IST) to deliver new integrated services. These results will provide powerful arguments for further exploitation and take-up of car-sharing.

¹⁰ Source: European Commission (1999), Annex 1 "Description of work"

2.3 WP3 'Operation and Measurement of Results' of Bologna Pilot

Within workpackage 3, ATC Bologna has the key responsibility for the real life operation of the pilot application and the measurement of results.

ATC will put the cars and the smart cards at users' disposal in order to start the real life operation phase. The pilot users will be able to access the system to: book via call centre and Internet and to use the cars. INVERS technically supports ATC in the starting phase. The same is true for Cambio Bremen, the experience of which will help ATC to resolve practical problems.

ATC and INVERS will collect and measure data on the mobility behaviour of each car-sharing customer. ATC will measure use of the car-sharing system by each customer. The system will allow to register the time spent and the mileage driven by each user. INVERS will programme the required statistic tools, according to the requirements of ATC for measurement of data for evaluation.

Through these quantitative measurements and through customer questionnaires and interviews, ATC will assess the user requirements and the prospects for further developing the system in the future.

2.4 Terminology

It is important to achieve consensus on the basics of the evaluation process in WP3 and WP4. As a first step, a common terminology should be used throughout the project. The purpose of this chapter is to explain evaluation terms and phrases essential for a good understanding of the process (see Table 4).

The proposed definitions are based on formal evaluation guidelines from the transport, environment, and health sectors of the Telematics Applications and the Transport Research Programme in the context of the Fourth Framework Programme.¹¹ Other sectors have not produced formal and compulsory guidelines for projects. It has been ensured that the terminology is also in line with the "Six steps for building evaluation into the Description of Work" of the "Guidelines for Contract Preparation for Co-ordinators of IST Projects."

Table 4: Evaluation Terms

Term	Definition
Application	The technical product of an RTD Project, usually a system or service as installed and operating in a real-life environment.
Appraisal groups	Different groups of users/ non-users affected by the impacts of an application. Benefits and drawbacks are estimated for these impacts. Appraisal groups involved in validating the application might include: <ul style="list-style-type: none"> • Operators of the application (car-sharing operator) • End users of the application (car-sharing users) • Third parties involved in the application (like call centre)

¹¹ The following is an adoption of definitions from within the Telematics Application Programme for the purposes of this project. It is based on the CONVERGE Checklist (see References). Additional background was provided by the VATAM Project Terminology Repository, March 2000 and the MAESTRO Project (Transport Research Prog.).

Term	Definition
Assessment	The general term for describing the process of systematically analysing and reporting the performance and/ or impacts of a candidate application. Analyses are usually undertaken in comparison to a reference case, and include an experimental process based on real-life trials, involving user interaction. The term is often used synonymously with evaluation.
Assessment objective	A precise statement of an individual objective of validation. It should be associated with a precise definition of the associated indicator(s) and definition of success.
Decision makers	People or groups who will be influential in determining whether verification results justify proceeding to the roll-out validation stage of validation, or moving into full implementation.
Definition of success	Before validating an application, the expectation about the performance and impacts of the application are defined. Success or failure of validation results are tested against these criteria. Thus it plays a vital role in the validation methodology. It is most exact when it is defined for a single indicator.
Evaluation	In this project, the term will be used synonymously with assessment as this reflects current usage (e.g. in the guidelines for 5FP contract preparation). The narrow definition of evaluation refers to the specific process of assigning quantitative and/ or qualitative characteristics ("values") to applications during validation and comparing them with expected values in order to derive recommendations for decision makers on the future use of an application (e.g. large-scale deployment).
Impact	Changes or effects brought about by an application resulting from its implementation in an experimental or real application, whether intended or unintended.
Indicator	A parameter, directly measured or derived from modelling, indicating the performance or impacts of an application.
Reference case	The performance and impacts of an application are usually compared against some existing situation in order to show to what extent the application meets required standards (e.g. in tests of the physical functioning of the application or user friendliness) and that use of the application is an improvement compared to alternative ways of achieving the objectives of the application (e.g. user acceptance, impact analysis). "Before and After" studies might feature assessment of user acceptance and impact analysis.
User groups	The group involved in validating the application: End users of the application (car-sharing users) This group should be a fair representation of the main future market for the application.
Validation	Validation is the specific process in an RTD Project of testing how an application performs with respect to the specified assessment objectives. Validation includes verification and a roll-out validation stage.
Verification	The verification stage of validation will use a small but sufficient sample of users in a real-life situation to test the technical feasibility of the demonstrator and to yield preliminary findings on user acceptance.

3 Operational Evaluation

The Operational Evaluation is the core chapter of the Detailed Evaluation Plan. It covers the operational evaluation in the project. A general overview over the TOSCA project (chapter 1) and the evaluation structure, procedure and terminology (chapter 2) has been given in the previous chapters.

After describing appraisal groups in chapter 3.1, the emphasis of the chapter lies on expected impacts and assessment objectives (chapter 3.2). The WP3 and WP4 teams (ATC, Rupprecht Consult, INVERS) supported by Cambio and the City of Bremen spent a considerable amount of time discussing, selecting, and defining indicators as well as indicators and assessment methods (chapter 3.4) and the evaluation tools (chapter 3.5). Chapter 3 concludes with an overview of future tasks (chapter 3.6).

3.1 Appraisal Groups

All groups of people affected by the impacts of the car-sharing pilot applications need to be identified. These groups are called "appraisal groups." For the most affected (or most important) groups benefits and drawbacks of the project will be estimated during evaluation. The following table specifies the identified TOSCA appraisal groups.

Table 5: Appraisal Groups

Appraisal Groups	
Car-Sharing Users¹²	<ul style="list-style-type: none"> • Users from the small business sector • Students • Residents
ATC	Car-sharing provider and operator
Intermediate	<ul style="list-style-type: none"> • Call centre (COTABO) • INVERS (system provider and support)

¹² For more detailed information see chapter 1.3.5.

3.2 Expected Impacts and Assessment Objectives

A practical approach was chosen in identifying impacts that are expected to arise through TOSCA. An impact is understood as a parameter, directly measured or derived from modelling, indicating the performance or impacts of an application.

Potential impacts that were considered non-measurable, unrealistic to achieve within the life-time of the project, or marginal in their effect were excluded from further discussion at early stages of the evaluation planning process.

The evaluation team identified the following impacts:

Table 6: Overview Impacts

Impact	
Impact 1	User friendly car-sharing system (user perspective)
Impact 2	Ease of operation (provider perspective)
Impact 3	Economic viability of commercial car-sharing operation in Bologna
Impact 4	Contribution to sustainability

In outline of all expected impacts and corresponding assessment objectives given hereafter.

Impact 1 'User friendly car-sharing system'

Description

Within the TOSCA project ATC Bologna will implement a car-sharing pilot application with nine vehicles, placed at three car-sharing locations.

It is expected that the car-sharing system in Bologna will be user friendly, ensuring convenient use for the car-sharing customers (e.g. IT tools, booking, accessibility of car-sharing location, vehicle availability).

Assessment Objectives

- Documentation of perceived quality of car-sharing service and operation (e.g. successful booking via internet or call centre, convenience and reliability of IT tools, geographical location of pickup points, variety of vehicles)

Impact 2 'Ease of operation'

Description

The TOSCA project expects to transfer proven innovative car-sharing technology of the car-sharing scheme in the City of Bremen to the public transport operator ATC. A car-sharing pilot application will be developed and implemented in Bologna.

TOSCA aims to achieve a trouble-free car-sharing service provision and operation in Bologna; e.g. telephone and online accessibility, secure booking and paying method, accounting, automatic registration of use data.

Assessment Objectives

- Measurement of drawbacks of car-sharing operation (based on INVERS support requestes by ATC Bologna, e.g. due to technical defects, wrong use by provider or user, number of accounting defaults)

Impact 3 'Economic viability of commercial car-sharing operation in Bologna'

Description

The goal of the TOSCA project is to implement a pilot car-sharing application in the City of Bologna, CarAtc, based on the implementation and business concept of the car-sharing system in Bremen. ATC is expected to establish an economically viable car-sharing operation in the future. This of course will need a certain time (for this reason TOSCA targets are projected for three years, see chapter 1.2.1).

Consequently, within the evaluation of pilot application economic viability will be expressed in terms of cost covering, under the condition new costumers acquired and existing costumers committed to use ATC Bologna's extended services.

Assessment Objectives

- Documentation of costs and benefits of car-sharing pilot (e.g. financial income, actual use, image)
- Documentation of future interest of pilot costumers in car-sharing

Impact 4 'Contribution to sustainability'

Description

The TOSCA project is expected to increase the quality of life in the city and bring benefits for the environment by reducing car ownership and car mileage.

TOSCA aims to achieve environmental improvement through the reduction of the multiple car ownership, reuse of urban space and the reduction of car CO₂ emissions.

Assessment Objectives

- Measurement of changes in mobility patterns (e.g. less use of other/more polluting cars), car ownership (cars replaced) and documentation changes in urban quality of life due to this (estimation of emissions saved, less space required for parking etc.)

3.3 Identified Indicators

For each of the four impacts, indicators have been identified. An indicator is understood as a parameter, directly measured or derived from modelling, indicating the performance or impacts of an application.

The following table gives an overview over possible indicators. Several potential indicators were considered not reliable to measure, unrealistic to derive exact results or their outcome would be zero. Thus these indicators were excluded from further evaluation steps. The table states which indicator been selected for TOSCA evaluation. Each selected indicator will be described more detailed further on.

Table 7: Overview (non-) selected Indicators

Indicator Nr.	Potential Indicators	Selected?
	Impact 1: User friendly car-sharing system	
1.1	Perceived customer satisfaction with car-sharing service in terms of: Geographical location of car-sharing pickup points Variety of vehicle types / State and safety of car-sharing locations / Condition of car (inside, outside)	Yes Yes No Both not selected because no priority for an IST project.
1.2	Perceived customer satisfaction with booking in terms of: Vehicle availability / Successful contact to call centre or completed online booking	Yes No Not selected because no priority for an IST project.
1.3	Perceived customer satisfaction with IT tools in terms of: Convenience of use Reliability of smart card	Yes Yes
/	Perceived customer satisfaction with service centre in terms of: Competence and friendliness Successful contact (easy to get in touch with)	No Not selected because no priority for an IST project.
	Impact 2: Ease of operation (provider perspective)	
2.1	Number of technical defects	Yes
2.2	Number of errors in use	Yes
2.3	Number of accounting defaults	Yes
/	Required action by operator due to malfunctioning of system	No Not relevant for the impact (but registered by INVERS).

Indicator Nr.	Potential Indicators	Selected?
/	Impacts on operator due to malfunctioning of system	No Not relevant for the impact (but registered by INVERS).
/	Security incidents, unauthorised access to system	No According to INVERS this has not been registered so far.
Impact 3 'Economic viability of car-sharing in Bologna'		
3.1	Number of users and use patterns	Yes
3.2	Income during the pilot application	Yes
3.3	Future interest of pilot costumers in car-sharing service	Yes
/	Growth potential of car-sharing in terms of awareness of car-sharing service of public transport users and Bologna citizens	No According to ATC Bologna a survey addressed to public transport users and others cannot be realised within the TOSCA project lifetime. ATC considers how this assessment can be carried out in the near future.
Impact 4 'Contribution to sustainability'		
4.1	Reduction of car use	Yes
4.2	Reduction of parking space	Yes
4.3	Reduction of CO² emission	Yes
/	Reduction of Noise	No No priority for an IST take up project; very complex registration.
/	Improvement of air quality (other then CO ² emission)	No No priority for an IST take up project; very complex registration.

Each selected indicators will be described in detail in the next chapters. Before this the employed indicator fact sheet and the possible assessment methods are introduced.

3.3.1 Indicators and Assessment Method

For the following description of each indicator, an indicator fact sheet format has been used. The table below gives a detailed an overview to its content.

Table 8: Indicator Fact Sheet – General Format

Impact x	
Indicator	A parameter, directly measured or derived from modelling, indicating the performance or impacts of an application.
Relevance:	Relevance for project goals, expectations and direction of indicator, contribution to measuring the impact, other background information
Key terms:	Description of any concepts and terminology, on which the indicator is based, e.g. what is equivalent to 100% etc.
Involved appraisal groups:	If applicable
Methods:	<p>For the method of indicator measurement, the following categorisation and terminology is suggested:</p> <ul style="list-style-type: none"> • Qualitative: Descriptions and interpretations that are put in words rather than in numeric values; sources include structured interviews, observations, hearings, documentations, professional judgement, simulations, etc. • Quantitative Manual (Statistics): Facts and statements represented in numeric values that are measured in a non-electronic way (statistics, lists, etc.) • Quantitative Electronic (Automatic): Facts and statements represented in numeric values measured electronically
Reference case:	<p>The performance and impacts of an application are usually compared against some existing situation in order to show that the application meets required standards (for tests of the physical functioning of the application and user acceptance) and that use of the application is an improvement on alternative ways of achieving the objectives of the application (for user acceptance again and impact analysis). "Before and After" studies might feature in assessment of user acceptance and impact analysis.</p> <p>Reference cases will vary with category of assessment objectives and may be required for individual indicators or be the same over a group of indicators or assessment objectives.</p>
Operational issues:	Any other points regarding measurement
Success criterion:	<p>This defines the expectation about the performance and impacts of the application. The success or failure of evaluation results is tested against this criterion. Therefore, it has a vital role in the evaluation methodology.</p> <p>According to the ANIMATE Guidelines definition of success should be given, as appropriate, for individual indicators, groups of related indicators, individual assessment objectives or groups of assessment objectives.</p>
References to other indicators:	Brief reference to other - similar – indicators

3.3.2 Indicators of Impact 1 'User friendly car-sharing system'

Within the TOSCA project the car-sharing pilot application "CarAtc" will be implemented with nine Smart cars, placed at three car-sharing locations in Bologna. It is expected that the car-sharing system in Bologna will be user friendly, offering car-sharing costumers:

*"... vehicle flexibility without the private, social and environmental cost of individual car ownership."*¹³

To ensure this, convenient use for the customers is vital for the car-sharing present and future operation (e.g. booking, IT tools, vehicle availability, accessibility of car-sharing location).

As costumers satisfied with car-sharing service are the basis for the system it is essential to analyse their wishes, requirements and perception of the service quality. With the evaluation of Impact 1 the car-sharing costumers 'get a voice' and the chance to express their opinion on their experience during the car-sharing pilot application. This information is not only important for TOSCA project evaluation, but also for the future development of Bologna car-sharing, as it provides the basis to decide whether services need to be adapted.

For the evaluation of impact 1 'User friendly car-sharing system' the following indicators will be used:

- Perceived customer satisfaction with car-sharing service
- Perceived customer satisfaction with booking
- Perceived customer satisfaction with IT tools

Indicator 1.1 'Perceived customer satisfaction with car-sharing service'

This indicator will measure customer satisfaction with the car-sharing service in Bologna. During the evaluation planning process it was agreed that two (of several possible) aspects of the car-sharing service will be analysed and selected as indicators, these are:

- Geographical location of car-sharing pickup points
- Variety of vehicle types

The geographical location of car-sharing pickup point has to meet the user needs. The longer it takes to reach a car-sharing pickup the fewer costumers will use it. For this reason it is essential to analyse the costumers satisfaction with location the car-sharing pickup points.

A diverse fleet of vehicles (including Smarts, family cars, vans etc.) is an important element of car-sharing service. During the pilot application, Smarts will be the only vehicles available. It will therefore be analysed in how far the costumers where satisfied with this vehicle type (or, in line with the CarAtc slogan "Just use a vehicle when you need one", if they would have needed another vehicle type).

The output of this indicator will be compared to the 'objective' data of Indicator 3.1. 'Actual Use'.

¹³ Source: ZEUS Project (2000), p. 74

Table 9: Indicator 1.1 'Perceived customer satisfaction with car-sharing service'

Impact 1:	User friendly car-sharing system
Indicator 1.1	Perceived customer satisfaction with car-sharing service in terms of - Geographical location of car-sharing pickup points and - Variety of vehicle types
Relevance:	The geographical location of car-sharing pickup point has to meet the user needs. During the pilot application, Smarts will be the only vehicles available. It will therefore be analysed in how far the costumers where satisfied with this vehicle type.
Key terms:	Car-sharing service: During the evaluation planning process it was agreed that two (of several possible) aspects of the car-sharing service will be analysed and selected as indicators, these are: <ul style="list-style-type: none"> - Geographical location of car-sharing pickup points - Variety of vehicle types Vehicle type: The vehicles used during the car-sharing pilot application are all the same type: Smarts.
Involved appraisal groups:	Car-sharing users
Methods:	Qualitative: TOSCA Survey Perceived customer satisfaction with car-sharing service concerning: <ul style="list-style-type: none"> - Car-sharing location Accessibility: <ul style="list-style-type: none"> - distance to next public transport - distance to user home/workplace - Variety of vehicle types
Reference case:	Bremen
Operational issues:	Italian school notes: 10 (very satisfied) to 6 (very unsatisfied)
Success criterion:	Positive balance of "good" marks.
References to other indicators:	3.1

Indicator 1.2 'Perceived customer satisfaction with booking'

Customer satisfaction with booking will be measured by analysing customer satisfaction with the call centre booking service, online booking and vehicle availability. Booking plays an important role, being main interface between user and the service operator. The users have the chance for direct contact, for asking further information about the CS station, how to get there and express specific desires, etc. – both for internet booking and for phone-booking. Besides booking is the key action for car-sharing use and should meet user needs very closely.

The information of indicator 1.2 will be compared with the 'objective situation' measured in Impact 2 'Ease of operation'.

Table 10: Indicator 1.2 'Perceived customer satisfaction with booking'

Impact 1:	User friendly car-sharing system
Indicator 1.2	Perceived customer satisfaction with booking in terms of - Vehicle availability and - Successful booking via call centre or successful online booking
Relevance:	Booking is the key action for car-sharing use and should be very user friendly.
Key terms:	Booking: Completion of wish to reserve car-sharing vehicle online via internet or through the CarAtc call centre
Involved appraisal groups:	Car-sharing users
Methods:	Qualitative: Survey pilot users Perceived customer satisfaction with booking concerning: A. Successful bookings or failed fulfilment of requested booking respectively Options: 1. Reservation could be carried out according to customer's wish. 2. The vehicle is available at the requested location, but at a slightly different time than requested by the customer. 3. At the desired time the vehicle was not available at the requested location, but at another location. 4. The reservation was not successful, because no vehicle available around the demanded time at any 'agreeable' location. B. Accessibility of the booking service (online, 24 h by phone)
Reference case:	Bremen
Operational issues:	Italian school notes: 10 (very satisfied) to 6 (very unsatisfied)
Success criterion:	Positive balance of "good" marks.
References to other indicators:	2.1, 2.2, 3.1

Indicator 1.3 'Perceived customer satisfaction with IT tools'

The transfer of IT tools is an important goal of the TOSCA project. It is the aim of this indicator to analyse the customer satisfaction with the reliability and convenience of use of the IT tools (smart card for booking, vehicle access, invoicing etc.).

The output of this indicator will be compared to the 'objective' data of Impact 2 'Ease of operation'.

Table 11: Indicator 1.3 'Perceived customer satisfaction with IT tools'

Impact 1:	User friendly car-sharing system
Indicator 1.3	Perceived customer satisfaction with IT tools in terms of - Convenience of use and - Reliability of smart card
Relevance:	Customers satisfaction with easy to use IT tools is vital for the success of an IST take up project
Key terms:	Convenience of use: Smart card, internet booking website and onboard computer should be easy to use, customers is lead through steps. Reliability of IT tools: Smart card should be 'unfailing' when used for internet booking, vehicle admission (check: customer ID and reservation ID for vehicle correct, invoicing etc.). The same applies for communication between booking computer and vehicle on-board computer.
Involved appraisal groups:	Car-sharing users
Methods:	Qualitative: Survey pilot users Perceived customer satisfaction with booking concerning: A. Convenience of use (easy to handle/understand, user interface) of: 1. Smart card 2. Internet booking website 3. Onboard computer B. Reliability of smart card concerning: 1. Internet booking 2. Vehicle access (check: customer ID and reservation ID for vehicle correct) C. Invoicing
Reference case:	Bremen
Operational issues:	Italian school notes: 10 (very satisfied) to 6 (very unsatisfied)
Success criterion:	Positive balance of "good" marks.
References to other indicators:	Indicators of impact 2

3.3.3 Indicators of Impact 2 'Ease of operation'

TOSCA aims to achieve a trouble-free IT-based car-sharing operation in Bologna. The impact analyses the ease of operation out of provider view (e.g. in relation to telephone and online booking or reliable). Besides it will be possible to establish whether Bologna is in line with other INVERS car-sharing implementations¹⁴.

The components used for car-sharing operation are the following:

Vehicle administration

COCOS Standalone System operates as car-sharing administration technology for Bologna. It is an onboard computer system for the reliable administration of vehicle pools, based on an on-board computer, a contact less smart card reader and a GSM modem.

Back office software

COCOS'2000 standard package is used as back office software (with additionally use of the Internet Software CocoWeb). This software configuration provides a LAN based distribution of administration clients, reservation clients and billing clients as well as a Internet based self-service reservation client. The included communication software CUCM performs the GSM communication.

Booking

Booking is done via internet or by telephone. 24 hour telephone reservations are handled by the Taxi Company Call Centre (COTABO)¹⁵. Internet booking will be done via an official website.

General information

General information on the car-sharing service, the public transport connections to the car-sharing locations is provided by an ATC call centre.

Smart cards

For booking and access to the car (in combination with PIN) the car-sharing costumers use smart cards.

On the bases of the INVERS experience specified categories of problems have been defined. INVERS will register the requests for support in the predefined categories: technical defects, errors in use and accounting defaults, these will be compared to the total number of realised bookings. By this analysis, the ease of operation will be derived.

For the evaluation of Impact 2 'Ease of operation' the following indicators will be used:

- Number of technical defects
- Number of errors in use
- Number of accounting defaults

¹⁴ For more details on Car-Sharing Technology see chapter 1.3.2.

¹⁵ Therefore the software module "CocoLite" will be installed into the taxi call centre. The taxi call centre staff will be able to perform simple reservation tasks (e.g. make a new reservation, edit and revoke existing reservations) via a TCP/IP connection with the central reservation system.

Indicator 2.1 'Number of technical defects'

This indicator will measure the number of technical defects on the basis of an INVERS' list of the total requests for support concerning technical defects. By comparing this data with the total number of realised bookings, this aspect of the 'ease of operation' will be derived.

The outputs of this indicator will be compared to the perceived customer satisfaction with the IT tools (see indicator 1.2 and 1.3).

Table 12: Indicator 2.1 'Number of technical defects'

Impact 2	Ease of operation
Indicator 2.1	Number of technical defects
Relevance:	Correct functioning of system essential for car-sharing service.
Key terms:	Technical defects concerning: <ul style="list-style-type: none"> - Vehicles - Onboard computers - Booking centre - Access/basic network problems (e.g. GSM-network or internet problems)
Involved appraisal groups:	/
Methods:	Quantitative Manual (Statistics): List of support requests concerning technical defects of: <ul style="list-style-type: none"> - Vehicles - Onboard computers - Booking centre - Access/basic network problems (e.g. GSM-network or internet problems)
Reference case:	No present reference case available so far. An interview will be held with experienced INVERS system support staff.
Operational issues:	ATC and INVERS will register the requests for support as listed under key terms. These will be compared to the total number of realised journeys.
Success criterion:	An overall error rate comparable to other IT-based car-sharing operations, defined by the maximum number of technical defects concerning: <ul style="list-style-type: none"> - Vehicles: - Onboard computers - Booking centre
References to other indicators:	1.2, 1.3

Indicator 2.2 'Number of errors in use'

Based on an INVERS' registration/list of the requests for support this indicator will measure the number of errors in use:

- Caused by car-sharing operator or costumers
- Due to incorrect input or system-parameter-definition
- Due to incorrect use of vehicle, onboard computer or self-service booking.

By comparing this data with the total number of realised bookings, this aspect of the 'ease of operation' will be derived.

The outputs of this indicator will be compared to the perceived customer satisfaction with the IT tools (see indicator 1.2 and 1.3).

Table 13: Indicator 2.2 'Number of errors in use'

Impact 2:	Ease of operation
Indicator 2.2	Number of errors in use
Relevance:	Correct functioning of system essential for car-sharing service
Key terms:	Errors in use: <ul style="list-style-type: none"> - Caused by car-sharing operator or customer - Due to incorrect input or system-parameter-definition - Due to incorrect use of vehicle, onboard computer or self-service booking
Involved appraisal groups:	/
Methods:	Quantitative Manual (Statistics): List of technical support requests concerning errors in use: <ul style="list-style-type: none"> - Caused by car-sharing operator or customer - Due to incorrect input or system-parameter-definition - Due to incorrect use of vehicle, onboard computer or self-service booking
Reference case:	No present reference case available so far. An interview will be held with a experienced INVERS system support staff.
Operational issues:	INVERS will register the requests for support as listed under key terms. These will be compared to the total number of realised journeys.
Success criterion:	An overall error rate comparable to other IT-based car-sharing operations, defined by the maximum number of errors in use concerning: <ul style="list-style-type: none"> - Caused by car-sharing operator or customer - Due to incorrect input or system-parameter-definition - Due to incorrect use of vehicle, onboard computer or self-service booking
References to other indicators:	1.2, 1.3

Indicator 2.3 'Number of accounting defaults'

As correct accounting is essential for car-sharing service, this indicator will measure the number of accounting defaults registered by the system. By comparing this data with the total number of realised bookings, this aspect of the 'ease of operation' will be derived.

The outputs of this indicator will be compared to the perceived customer satisfaction with the IT tools (see indicator 1.3).

Table 14: Indicator 2.3 'Number of accounting defaults'

Impact 2:	Ease of operation
Indicator 2.3	Number accounting defaults
Relevance:	Correct functioning of accounting is essential for car-sharing service.
Key terms:	Accounting defaults: Automatic system, results e.g. <ul style="list-style-type: none"> - Vehicle booked, but no journey - Vehicle booked, but no data available - Journeys unpaid, but customer removed from the programme (system error)
Involved appraisal groups:	/
Methods:	Quantitative Electronic (Automatic): Output of automatic accounting check by booking system Quantitative Manual (Statistics): Logbook in CarAtc vehicle Filled in by customers – special test persons should be selected to ensure that certainly their logbooks are filled in carefully.
Reference case:	No present reference case available so far. An interview will be held with experienced INVERS system support staff.
Operational issues:	INVERS will register the requests for support as listed under key terms. These will be compared to the total number of realised journeys.
Success criterion:	An overall error rate comparable to other IT-based car-sharing operations, defined by the maximum number of defects.
References to other indicators:	1.3

3.3.4 Indicators of Impact 3 'Economic viability of car-sharing in Bologna'

Based on the implementation and business concept of the car-sharing system in Bremen, the car-sharing pilot application in the city of Bologna is expected to establish an economically viable commercial car-sharing operation in the future. As CarAtc is a supplementary service to ATC 'classic' public transport operation a win-win situation for both services is expected. This, of course, will need a certain time period.

For this reason 'economic viability' will be expressed in TOSCA evaluation (at the end of the pilot application) in terms of covering marginal operational costs, under the condition new costumers acquired and existing costumers committed to use ATC Bologna's extended services.

In a later state of the Bologna car-sharing operation beyond TOSCA 'economic viability' should be understood 'as the absence of outside funding (EU and national/local funding), sufficient number of regular costumers and vehicles to allow long term operation of a commercial car-sharing service (under market conditions)'.

For the evaluation of Impact 3 the following indicators will be used:

- Actual use patterns of pilot users
- Income during the pilot application
- Future interest of pilot costumers in car-sharing service

Indicator 3.1 'Number of users and use patterns'

The indicator will measure the actual car-sharing use during the pilot application in terms of 'use of capacity' of each car-sharing location and 'use over time' (day, week, month, , total pilot duration).

Table 15: Indicator 3.1 'Number of users and use patterns'

Impact 3	Economic viability of car-sharing in Bologna
Indicator 3.1	Number of users and use patterns
Relevance:	Measure actual use of car-sharing during pilot application. This is basic information required to assess actual and future economic viability of car-sharing in Bologna.
Key terms:	Full capacity use: ATC Bologna specifies whether full capacity use is equal to customer use e.g. - once a day - 8 hours per day - 24 hours per day.
Involved appraisal groups:	Car-sharing pilot users – indirectly
Methods:	Quantitative Electronic (Automatic): System registration of: A. Booking media (call centre, online) B. Use over time (per location and day, week, month, total pilot duration)
Reference case:	Bremen (Dresden for B., C.)
Operational issues:	To assess the 'actual use' the use capacity of different locations will be measured over the time (duration) of the pilot application. The information will be collected per car-sharing location and per car-sharing user.
Success criterion:	100 regular car-sharing customers
References to other indicators:	All other indicators

Indicator 3.2 'Income during the pilot application'

This indicator will measure the income attained during the car-sharing pilot application in Bologna.

ATC personnel costs, as well as the call centre (for CarAtc booking) and appliance costs, are currently covered by the TOSCA project. Investment costs related to cars will not actually arise as the Smart car dealer has provided the vehicles for the whole project experimentation at no charge.

ATC expects total marginal operational costs of about 60.000.000 Lira (including insurance, fuel, maintenance, administration, cleaning, marketing, telephone traffic).

Table 16: Indicator 3.2 'Income during the pilot application'

Impact 3	Economic viability of car-sharing in Bologna
Indicator 3.2	Income during the pilot application
Relevance:	Based on the implementation and business concept of the car-sharing system in Bremen pilot the application in the city of Bologna is expected to establish an economically viable commercial car-sharing operation in the future.
Key terms:	Income: Income generated from car-sharing during Bologna trial.
Involved appraisal groups:	ATC Bologna
Methods:	Quantitative - Calculation/Measurement of income at the end of pilot application
Reference case:	Data Cambio Bremen (not confirmed yet)
Operational issues:	Calculation will be done on the basis of the tariff structure defined from ATC (£. 2500/h – 500/km) by calculating the mileage and the time of vehicle use.
Success criterion:	Income of about 100.000.000 Lira at the end of the pilot application.
References to other indicators:	3.1

Indicator 3.3 'Future interest of pilot costumers in car-sharing service'

This indicator will assess interest of pilot costumers to use in car-sharing service in the future and under which conditions as well as their willingness to recommend car-sharing to others.

This indicator generates basic information for the growth potential of Bologna car-sharing.

Table 17: Indicator 3.3 'Future interest of pilot costumers in car-sharing service'

Impact 3	Economic viability of car-sharing in Bologna
Indicator 3.3	Future interest of pilot costumers in car-sharing service
Relevance:	Analyse future interest of pilot costumers in car-sharing service and willingness to recommend car-sharing in order to get an indication for growth potential of Bologna car-sharing.
Key terms:	/
Involved appraisal groups:	Car-sharing pilot users
Methods:	Qualitative: Survey pilot users <ul style="list-style-type: none"> - Interest to use car-sharing in the future and under which conditions - Willingness to recommend car-sharing
Reference case:	Bremen, Dresden
Operational issues:	
Success criterion:	Majority of pilot car-sharing costumers indicate that they will to use service in the future. Majority of pilot car-sharing costumers is willing to recommend the service to others.
References to other indicators:	Indicators of Impact 1, 4.1

3.3.5 Indicators of Impact 4 'Contribution to sustainability'

The TOSCA project is expected to contribute to sustainability with the car-sharing take-up in Bologna by reducing car mileage and car use. Because with car-sharing

"... fewer cars are needed to meet the mobility needs of a given number of people and so the city becomes a more attractive place to live in." ¹⁶

Bologna car-sharing "CarAtc" promotes the slogan "just use a car when you need one". In line with this no basic fee is due to encourages costumers to drive only when necessary. The pay-as-you-drive structure is based on the mileage driven and the duration of the trip with no free mileage.

To evaluate Impact 4 'Contribution to sustainability' the following indicators will be used:

- Reduction of car use
- Reduction of parking space
- Reduction of CO² emission

Indicator 4.1 'Reduction of car use'

This indicator documents any change in car use stated by the car-sharing pilot users. Research has revealed that every car-sharing vehicle has the potential to replace between four and ten private cars¹⁷. Thus a reduction of car use is expected in Bologna due to the car-sharing service. For the moment the operation runs as a pilot, so costumers can not be sure whether the service is timely limited or not. For this reason the indicator measures both the present decision and future intention to reduce car use.

Analogue to the different pilot users groups different are expected to bring about the reduction in car use (for details on car-sharing users see chapter 1.3.5.).

For users from the small business sector' (like advocates or architects) car-sharing may fulfil (fully or partly) the car-borne mobility needed for the job. Thus office car(s) can be reduced or totally abandoned.

The Bologna car-sharing service should encourage students not to bring a car from their hometown and, on the long run, 'prevent' to acquisition of an own private car.

For residents living near the car-sharing location the CarAtc vehicles may satisfy the mobility request usually fulfilled by a second car and thus promote the reduction of second-car-ownership in Bologna.

¹⁶ Source: ZEUS Project (2000), p. 74

¹⁷ Source: ZEUS Project (2000), p. 74

Table 18: Indicator 4.1 'Reduction of car use'

Impact 4	Contribution to sustainability
Indicator 4.1	Reduction of car use
Relevance:	Document the reduction of car use due to car-sharing service. It is a basic indicator to measure the contribution to sustainability.
Key terms:	Car use can comprise the present or future: <ul style="list-style-type: none"> - The pure utilization of a car (owned, borrowed or rented) - The ownership of a private or office car
Involved appraisal groups:	Car-sharing pilot users
Methods:	Qualitative: Survey pilot users Indication of: <ul style="list-style-type: none"> - Changes in car use (utilization of rented or borrowed cars; change to low energy consumption / low emission standard vehicle) - Changes car ownership (present, future; type of replaced car) - Change in driven kilometres
Reference case:	Bremen, Dresden
Operational issues:	De facto information or intention stated by the car-sharing pilot costumers. (Actual reduction of registered cars cannot be expected due to the pilot character of the car-sharing service.)
Success criterion:	Expressed intention of 25% car-sharing costumers to give up a car or <u>not</u> to buy one due to car-sharing service in the future under the premises that car-sharing service will continue. For students also: expressed intention not to bring a car from hometown anymore
References to other indicators:	3.1 Basic indicator for 4.2, 4.3

Indicator 4.2 'Reduction of parking space'

This indicator indicates the land estimated to be “freed” from parking use due to car-sharing. As specified before, car-sharing has the potential to reduce car use in the city. Research reveals that

“... every car sharing vehicle [...] saves at least five parking spaces.”¹⁸

Consequently¹⁹, it can be presumed that less parking space is needed in Bologna. This space can be assigned to other use, and thus contribute to a more diverse, recreational and/or ecological urban land use.

Table 19: Indicator 4.2 'Reduction of parking space'

Impact 4	Contribution to sustainability
Indicator 4.2	Reduction of parking space
Relevance:	Indicates the land estimated to be “freed” from parking use due to car-sharing. This increase in urban space available for more diverse use demonstrates the broad contribution of car-sharing to sustainability.
Key terms:	/
Involved appraisal groups:	/
Methods:	Base: results of 4.1 (Quantitative: Registration of the City of Bologna of amount of urban space, (public) parking space as background data)
Reference case:	Bremen
Operational issues:	Calculation the estimated amount of “freed” urban parking space on the basis of indicator 4.1 information. Considering that each CarAtc can replace 4 cars. (Actual reduction of registered cars cannot be expected due to the pilot character of the car-sharing service.)
Success criterion:	360 m ² surface of urban space freed from car parking use.
References to other indicators:	3.1, 4.1

¹⁸ Source: ZEUS Project (2000), p. 74

¹⁹ Under the premises that (even by growing number of habitants) the political intention persists to keep car out of the city.

Indicator 4.3 'Reduction of CO² emission'

This indicator indicates estimated reduction of CO² emission due to less driven kilometres, plus less necessary vehicles (life-cycle calculation). The indicator refers only to changes due to the reduction of vehicle mileage and car ownership. Besides car-sharing vehicles often replace old cars with higher pollution than the modern car-sharing fleet.

Only an indication of the estimated reduction per mileage of CO² emission can be calculated as it depends on factors like:

- Vehicle type and performance
- Driving styles
- Duty cycle
- Traffic conditions

As an average of the fleet about 200 g/km can be seen as direct CO² savings. If the mileage is partly replaced by Public Transport this amount should be reduced by about 20 g/km (as about 30 – 35 g/km can be calculated as an average).

The usual life-cycle calculation per replaced vehicle includes the energy which is used for the production of raw-materials, the necessary transport and the vehicle production itself. Existing average calculation models will be used (see ZEUS project).

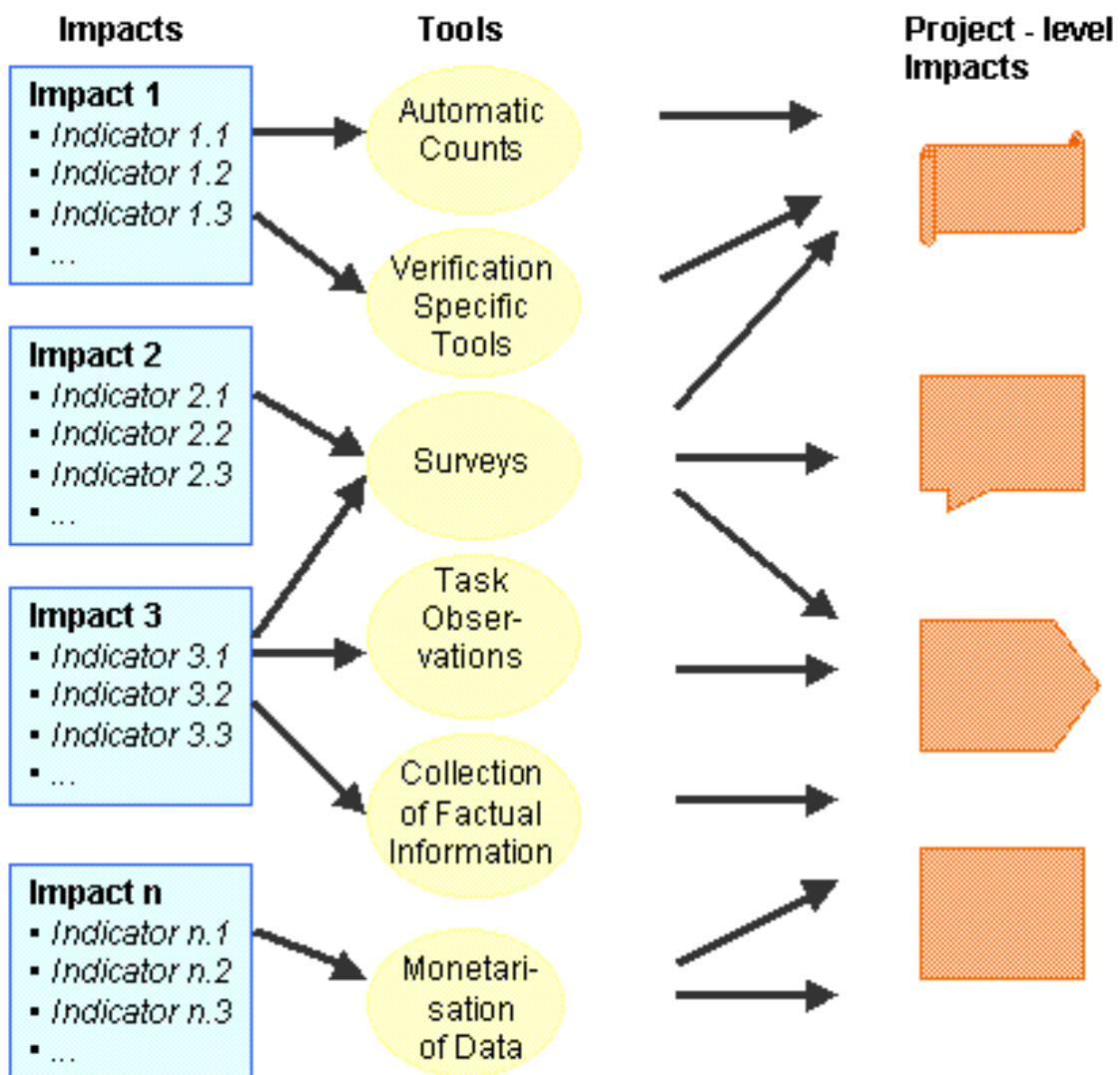
Table 20: Indicator 4.3 'Reduction of CO² emission'

Impact 4	Contribution to sustainability
Indicator 4.3	Reduction of CO ² emission
Relevance:	This indicator indicates the estimated reduction of CO ² emission the due to the reduction of driven kilometres.
Key terms:	Life cycle assessment: Assessment of emissions produced throughout its life cycle. Includes the entire chain from vehicle and fuel production to the use and ultimate disposal or recycling of the vehicle. The analysis will not include emissions associated with servicing vehicles or disposing / recycling at the end of their use. Tank to wheel analysis: Analysis of the exhaust emission from the vehicle
Involved appraisal groups:	/
Methods:	Quantitative: Registration of - Distance travelled - Service/maintenance events
Reference case:	Bremen
Operational issues:	Calculation of life-cycle energy/emissions savings based on life-cycle calculation models (see ZEUS project). The life-cycle analysis is based upon GEMIS model of Eco-Institute Darmstadt.
Success criterion:	Reduction up to 4 tons of CO ₂ (due to +/- 20.000 Km saving, during pilot).
References to other indicators:	3.1, 4.1

3.4 Evaluation Tools

The indicators have been described in a systematic way within the context of the impacts they aim to measure. During the practical exercise it will be important to achieve an efficient and co-ordinated approach towards actual measurement (bearing in mind comparability to Bremen and other car-sharing evaluations). Therefore, the outlines of the operational evaluation tools have been designed which enables to approach the data collection in a co-ordinated manner and to save resources. One tool can appropriately measure more than one indicator (e.g. a questionnaire can address a couple of divers issues). The integration of these tools in the process of operational evaluation is illustrated in Figure 6.

Figure 6: Integration of Measurement Tools in the Evaluation Process



The process in developing tools in TOSCA involves:

1. For each indicator the suitable methods of measurement are currently being identified (compare chapter 3.3.2-3.3.5), including a characterisation of targeted appraisal groups.
2. Tools will be finalised and translated (immediately following the completion of the DEP).

Categories of common tools

The following categories of tools will be developed jointly by WP3 and WP4 applied during the course of the pilot application:

- Automatic Counts/ Manual Registration
- Surveys
- Collection of Factual Information

Counts/Registration: a specific set of requirements are currently being defined for automatic or manual measurement of data (e.g. system registration of booking time and travelled distance in total, per customer, manual registration of system defects).

It is expected that data will be made available in a crude form automatically by system components in regular time intervals.

Surveys: Questionnaires are one of the standard tools of empirical social research and are commonly summarised under the category "survey." In the context of TOSCA evaluation, the more specific understanding is that questionnaires should be comparable to other (especially the Bremen) car-sharing evaluation. The surveys are mainly concerned with the collection of opinions, stated preferences or judgements on quality from pilot users of car-sharing, public transport users in general.

In order to yield a sufficient number of valid results, questionnaires will be relatively brief and will be of course made available in Italian as well as in English.

Collection of Factual Information: Two categories of "factual" information will be collected:

- Simple facts which can only be collected manually, usually without involving an appraisal group directly
- Qualitative "surveys," i.e. in-depth interviews with INVERS system support, decision makers, key personnel, and specific groups of potential end users).

These interviews will be undertaken in a semi-structured manner: an interview guideline will outline a briefing to the interviewee, kick-off and prompting questions and key issues for which statements should be collected, as well as a common format for recording and analysing responses.

The concrete/actual tools will be added as an annex to the Detailed Evaluation Plan, when available.

3.5 Future Evaluation Tasks

Following the completion of the TOSCA Detailed Evaluation Plan, the following tasks will be undertaken:

- Elaboration of evaluation tools to be used to measure indicators in a way ensuring comparability to Bremen and other car-sharing evaluations
- Agreement on measurement conditions and statistical and methodological issues (e.g. how to achieve representative data, how to sample, integrity of assessment, etc.), and
- Fix a detailed timetable for WP3 and WP4 evaluation tasks.

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